

Legacy of the wood chemical industry in the Alleghenies: Potential environmental hazards associated with residual waste material

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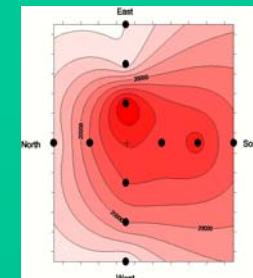
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McKean County had more wood chemical plants than any other PA county due to its cheap natural gas and abundant hardwood supplies. Operations were integrally linked to those of the regional lumber railroads and sawmills. Plants were initially small but became larger with the invention of the “jumbo retort” in 1898, which allowed the processing of four carloads of wood (each 2.5 cords) at once.



Using a fluorometer, we were able to rapidly assess the relative distribution of PAHs in soil at a former wood chemical plant site in McKean Co. The method involves a 2 min extraction of soil with methanol and can be done immediately at the site.



Introduction

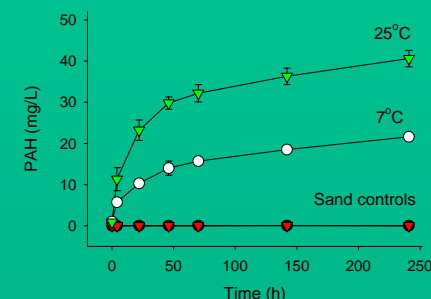
Over 70 wood chemical plants operated in northern Pennsylvania between ca. 1890 and 1950, all located within 72 kilometers of the NY state border. Their original purpose was to salvage the small unwanted hardwood trees left behind by the lumber mills and to make charcoal, calcium acetate and methanol for a growing number of industrial uses. Scrap timber was loaded into large metal retorts, which were then heated, driving off volatile compounds by destructive distillation and leaving the charcoal behind. One byproduct of this process was a large amount of wood tar, which was sometimes burned as fuel, but more often dumped locally. By the 1920s and 1930s, the industrial demand for the products of the wood chemical plant had declined, or cheaper methods of manufacture had been developed, so the industry slowly disappeared. At many old wood chemical plant sites, wood tar remains as a residual contaminant, and in some locations, polyaromatic hydrocarbons (PAHs) in these tar deposits pose a pollution hazard to aquatic life in nearby streams. In this paper, we describe our initial research on the composition and properties of residual wood tar, its rapid field detection at historic wood chemical plant sites using methanol extraction and fluorometry, and the relative aqueous solubility and toxicity of wood tar at different environmental temperatures.



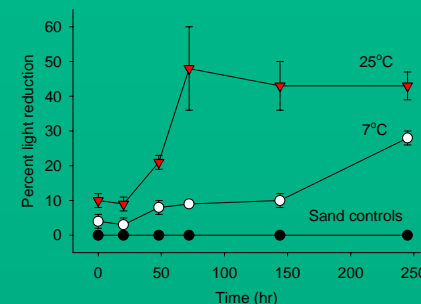
A wood tar seep on the banks of the Kinzua Creek, near Kushequa, PA. The tar becomes more fluid in warm weather, and tends to seep from soil-covered dumps and, in many cases, work its way downhill towards nearby streams.

Organic analysis of wood tars (right) revealed the presence of numerous volatile and semi-volatile compounds typical of the destructive distillation of wood, including phenols and polycyclic aromatic hydrocarbons (PAHs). PAHs are of particular concern due to their toxic, mutagenic and carcinogenic properties.

| Volatiles | Semi-volatiles |
|---------------------------|--------------------|
| tetrahydrofuran | phenol |
| isobutyl alcohol | 2-methylphenol |
| benzene | 4-methylphenol |
| 1,4-dioxane | naphthalene |
| 4-methyl-2-pentanone | acenaphthene |
| toluene | fluorene |
| ethylbenzene | anthracene |
| xylene | fluoranthene |
| isopropylbenzene | benzo(a)anthracene |
| 1,1,2,2-tetrachloroethane | chrysene |
| 1,2,4-trimethylbenzene | |
| hexachlorobutadiene | |
| naphthalene | |
| n-propylbenzene | |
| 1,3,5-trimethylbenzene | |
| 1,2,4-trimethylbenzene | |
| sec-butylbenzene | |
| n-butylbenzene | |



Lab experiments confirmed that the release of aromatic organic compounds from wood tar into water was likely to be more rapid in the summer than the winter.



We also measured the relative toxicity of the compounds released from wood tar under summer and winter conditions. This was measured by determining the decrease in light production by luminous marine bacteria via the Microtox assay. These results generally paralleled the PAH release rates shown previously.

Conclusions

1. Relict wood tar deposits from abandoned wood chemical plants found throughout the Allegheny Mountain region contain potentially harmful polycyclic aromatic hydrocarbons and other organic compounds.
2. These aromatic organics are at least partially soluble in water, especially during the summer months.
3. Soil extraction with methanol allows the rapid detection of wood tar contamination at impacted sites.
4. Research to determine the potential environmental impacts and natural bioremediation of wood tar is currently underway.



Chemical wood being taken by wagon to the rail head. Hardwood was cut to a length of 52" and split so that it could be loaded into cast iron cylindrical retorts.